



W.W. HANSEN EXPERIMENTAL PHYSICS LABORATORY

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October 2, 1995

Dr. Vern N. Smiley
Scientific Officer Code: 1262
Office of Naval Research
800 North Quincy Street
Arlington, Virginia 22217-5000

Reference: ONR Grant N00014-91-J-4152
Final Project Report

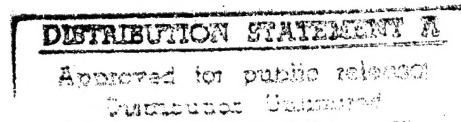
Dear Mr. Clausen:

Enclosed please find three copies of our Final Technical Report for the grant effort referenced above, covering the research period 8/15/91 through 3/31/95. Additional copies of this report have been mailed to the addressees listed in the Reports and Report Distribution attachment to the Grant Schedule.

Please call (415-725-2257) if you have questions.

Sincerely,

Robin J. Maslin
Assistant Director, HEPL



cc: L. Clausen, AGO (1 copy)
Director, NRL (1 copy)
DTIC (2 copies)
H.A. Schwettman
V. Mallace, SPO

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To: Robert Farnsworth

October 2, 1995

From: Todd Smith

Subject: Final Report for Contract N00014-91-J-4152, Evaluation of a 500 MHz Superconducting RF Cavity for FEL Applications

Funds provided under ONR Contract N00014-91-J-4152 were provided to evaluate the suitability of a 500 MHz superconducting cavity for use in linear accelerators intended for high power FEL applications. There were to have been two phases. The work to have been done under Phase I consisted of that to prepare the cavity (purchase under a previous contract) and its auxiliary components for cryogenic tests, and the cryogenic tests. The work under Phase II was to have emphasized tests in which the cavity's performance with an electron beam was studied.

Under Phase I a variety of investigations were initiated and successfully completed.

The sensitivity to mechanical vibration of the cavity and the cryogenic dewar designed for it by a commercial manufacturer was studied experimentally and theoretically. The sensitivity was found to be excessive. Utilizing the information obtained from the tests, a new system was designed which should be substantially better.

The RF design of the high-order mode (HOM) couplers was extensively evaluated and tested. Collaborators at the Lawrence Berkeley National Laboratory (LBL) made thorough room temperature measurements of the 500 MHz cavity at LBL, and then assembled the cavity and dewar system here at Stanford for cryogenic tests. Detailed analysis of the data revealed the coupler design to be inadequate to allow the cavity to be used in its originally intended application.

Collaborators at the Brookhaven National Laboratory designed and built an RF control system intended for feedback regulation of the amplitude and phase of the RF fields inside the cavity. The system was tested successfully on the Cornell University storage ring.

Work under Phase I resulted in ten publications (see attached bibliography).

Significant effort was expended under Phase II in designing and preparing for electron beam experiments. Although the scope and nature of the tests underwent several re-evaluations during the term of the contract, eventually it was decided that the tests would make use of an electron beam to be provided by an accelerator under construction at Boeing Aerospace Corp. in Seattle. These tests were never begun due to a change in the US Government's philosophy regarding the program of which these cavity tests were a part.

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Mechanical Modes of Multicell Linac Structures, A. Marziali and H. A. Schwettman, Proceedings of the 5th Workshop on RF Superconductivity, ed. D. Proch, DESY Report **M-92-01**, 782 (1992).

Structure Fabrication and Control of Higher Order Modes, A. Marziali, H. A. Schwettman and J. G. Hatmaker, Proceedings of the 5th Workshop on RF Superconductivity, ed. D. Proch, DESY Report **M-92-01**, 802 (1992).

Microphonics and RF Stabilization in Electron Linac Structures, H. A. Schwettman, Proceedings of the 5th Workshop on RF Superconductivity, ed. D. Proch, DESY Report **M-92-01**, 931 (1992).

Microphonic Measurements on Superconducting Linac Structures, A. Marziali and H. A. Schwettman, 1992 Linear Accelerator Conference Proceedings, ed. C. R. Hoffman, AECL-**10728**, 704 (1992).

Structure Tuning and Its Effect on Higher Order Modes, A. Marziali and H. A. Schwettman, 1992 Linear Accelerator Conference Proceedings, ed. C. R. Hoffman, AECL-**10728**, 707 (1992).

RF Linacs for FELs, H. A. Schwettman, 1992 AECL Linear Accelerator Conference Proceedings, ed. C. R. Hoffman, AECL-**10728**, 275 (1992).

Field Profile and Loading Measurements on Higher Order Modes in a Two Cell 500 MHz Superconducting Structure, W. Barry, J. Edighoffer, S. Chattopadhyay, 1992 Linear Accelerator Conference Proceedings, ed. C. R. Hoffman, AECL-**10728**, 151 (1992).

Microphonic Analysis of Cryo-Module Design, A. Marziali and H. A. Schwettman, Proceedings of the 1993 Particle Accelerator Conference, ed. , IEEE Cat. No. , (1993).

Vibrational Analysis of the Tesla Structure, A. Marziali and H. A. Schwettman, Proceedings of the 6th Workshop on RF Superconductivity, ed. R. M. Sundelin, CEBAF-October 1993, 1192 (1994).

Microphonics in Superconducting Linear Accelerators and Wavelength Shifting in Free Electron Lasers, A. Marziali, Ph. D. dissertation, Stanford University (1994).